Exercise 1. Attribute Closure

Relation (A, B, C, D, E, G) has following functional dependencies:

AB → C

C → A

BC → D

ACD → B

D → EG

BE → C

CG → BD

CE → AG

Build Attribute Closure (BD)+

Solution

{BD} D → EG {BDEG} BE → C {BCDEG} C → A {ABCDEG}

Exercise 2. Functional dependencies

Look at relation Order (ProductNo, ProductName, CustomerNo, CustomerName,OrderDate,UnitPrice, Quantity, SubTotal, Tax, Total)

Tax rate depends on the Product (e.g., 20% for books or 30% for luxury items).

Only one order per product and customer is allowed per day (several orders are combined).

A) Determine the non-trivial functional dependencies in the relation

B) What are the key candidates?

Solution

A)

{ProductNo} → {ProductName, UnitPrice, Tax}

{CustomerNo} → {CustomerName}

{ProductNo, CustomerNo, OrderDate} → {Quantity}

{UnitPrice, Quantity} → {SubTotal}

{SubTotal,Tax} → {Total}

{ProductName} → {ProductNo}

{CustomerName} → {CustomerNo}

The last two are valid only if the product/customer names are unique.

Because of the correlation between SubTotal, Tax and Total, one could consider the following functional dependencies as well:

{Total,Tax} → {SubTotal}

{Total,SubTotal} → {Tax}

B)

{ProductNo, CustomerNo, OrderDate}

{ProductNo, CustomerName, OrderDate}

{ProductName, CustomerNo, OrderDate}

{ProductName, CustomerName, OrderDate}

The last two are valid only if the product/customer names are unique.

Exercise 3. 3NF

Consider relation R(A, B, C, D) with the following functional dependencies:

F = {A→D, AB→ C, AC→ B}

A) What are all candidate keys?

B) Convert R into 3NF using synthesis algorithm from textbook.

Solution

A)

AttrClosure (F, AB) = {AB}->{ABD}->{ABCD} => AB is superkey

AttrClosure (F, A) = {A}->{AD}

AttrClosure (F, B) = {B}

AB is candidate key

AttrClosure (F, AC) ={AC}->{ACD}->{ABCD} => AC is superkey

AttrClosure (F, A) = {A}->{AD}

AttrClosure (F, C) = {C}

AC is candidate key

B)

A→D => R1 = {A, D}

AB→C => R2 = {A, B, C}

AC→B => R3 = {A, C, B}

R3=⊆ R2 => R1 = {A, D}; R2 = {A, B, C}